Atmospheric Radiation Measurement Program

Facilities Newsletter – July 1999

SGP99 Hydrology Campaign

Summer research efforts continue in July with the SGP99 Hydrology Campaign headed by the United States Department of Agriculture, Agricultural Research Service. Other participants are the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration, and the ARM Program. This campaign will focus on measuring soil moisture by using satellite-based instruments and takes place July 7-22, 1999.

Soil moisture is an important component of Earth's hydrologic cycle and climate, but our understanding of it and our ability to measure it accurately are limited. Scientists need to understand soil moisture better so that it can be incorporated correctly into general circulation models.

As an important factor in growing crops, soil moisture dictates a farmer's success or failure. Too much soil moisture can drown out croplands and cause flooding, whereas too little can lead to drought conditions, robbing crops of their life-supporting water. Decisions about which crops to plant and other land use issues depend on our understanding of soil moisture patterns.

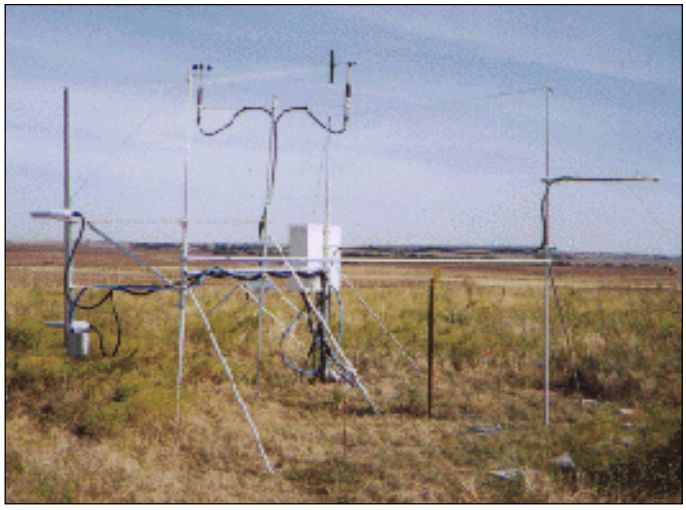

Figure 1. Energy balance Bowen ratio system.

Soil moisture can be measured in various ways. ARM employs several direct methods using soil moisture probes buried from 1 inch to 6.5 feet below the surface. One type of probe has two stainless steel screens separated by a piece of fiberglass. Electrical resistance, which is a function of soil moisture content, is measured between the screens. Another type of probe measures soil temperature and the increase in temperature after the soil is heated by small heating element. From this measurement, the volume of water in the soil can be calculated.

To measure soil moisture, ARM uses the energy balance Bowen ratio system (Figure 1) and the soil water and temperature system located at each extended facility. Taking valid soil moisture

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measurements is complicated by soil type and ground cover in the sample area. Rocks or sand in the soil can also interfere. Each soil moisture probe must be calibrated to the soil in which it will be used.

Installing enough in-ground soil moisture probes to make measurements all over a large area is impractical. Scientists are therefore investigating the possibility of extracting soil moisture information from satellite data. Satellites have the advantage of providing vast amounts of data for large surface areas. The difficulty in using satellite data lies in trying to interpret the data in terms of meaningful quantities. Accomplishing this is one of the goals of SGP99.

Figure 2. The NASA P3-B aircraft that will carry instruments over the CART site during SGP99. (Source: http://www.wff.nasa.gov/~apb/

During the two-week scientific campaign, instruments like the ones to be launched on a satellite in late 2000 will be installed on a NASA P3-B aircraft (Figure 2). The aircraft will fly designated patterns over a portion of the CART site and will collect data to be used in developing and verifying methods for extracting soil moisture values from the satellite data.

To verify the methods developed with the aircraft data, measurements must be made simultaneously on the ground. The ground data, referred to as "ground truth," consist of soil moisture samples, data from soil moisture probes, soil and surface temperature, soil bulk density measurements, ground-penetrating radar scans, surface flux measurements of latent and sensible heat, standard meteorological measurements, radiometric measurements, and atmospheric soundings. Scientists will use the ground truth data to develop and verify data analysis programs and to explore new approaches for enhancing our ability to measure soil moisture from space.